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(54) IMPROVEMENTS RELATING TO CENTRIFUGES

(71) We, WESTFALIA SEPARATOR A.G., a German Body Corporate, of 4740 Oelde 1/Westfalen, Postfach 2420, Federal Republic of Germany, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to a method of operating a centrifuge adapted to separate a specifically lighter liquid component of a solids-liquid mixture in a self-emptying drum of the centrifuge, and to a centrifuge
 15 for separating such a specifically lighter liquid component from such a mixture.

In these arrangements the specifically heavier of the liquid components is led away from the drum by means of a conduit having a valve therein which conduit is fed by a paring disc or is hermetically connected to the drum and in which conduit a throttling device is incorporated. The expulsion takes place before the discharge orifices in the outer wall of the drum for the discharging of the solid materials separated from the liquid mixture are opened. In this way loss of the specifically lighter useful liquid which is still in the drum is
 30 avoided.

Control devices are almost generally used for controlling the necessary valves and for maintaining the required holding times. Such a control device is for example known
 35 from German Patent No. 1,142,795.

In the case of separating drums which centrifuge out only the solid contaminants from single-phase or multi-phase liquids without at the same time separating liquid mixtures into their components, expulsion of the liquid filling the central part of the drum takes place relatively easily. Drums of this kind have only one liquid discharge outlet. After the solids compartment has
 45 filled, for the purpose of completely

emptying the drum, first the centrifuge feed-stock inlet valve has to be closed and then the feed has to be switched to a specifically heavier displacement liquid. The valve is held open by the control device until the useful liquid is forced inwards from the drum. The required amount of displacement liquid is approximately equal to the volume of the drum less the volume of the solids chamber.

So long as the clarified liquid is conducted away by a paring disc or a conduit hermetically connected to the drum, a valve in this conduit has to close before the valve for the control fluid which effects the opening of the discharge orifices for the solids is switched over. In this way losses through reverse flow of the useful liquid into the drum during the emptying process are avoided. After the drum is emptied, all valves have to be switched over again in reverse sequence.

In the case of separator drums which, in addition to centrifuging specifically heavier solids, separate the liquid mixture into its components, the expulsion of the specifically lighter liquid component poses a problem. This expulsion only comes into consideration if the specifically lighter liquid is the useful component. Included in such centrifuge solids liquids mixtures are, for example, fish-presswater or oils contaminated by solids and water.

Separator drums have two liquid outlets for the liquid components separated from each other. Their distance from the axis of rotation is normally so arranged that the interface between the separated liquid components lies within the ascending channels of the plate unit. In order to force the specifically lighter liquid component from the drum, the interface must be shifted to the inner-free liquid level of the lighter liquid component.

In separator drums with free outlet for

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the two liquid components via regulating discs, the position of the interface corresponding to the difference in density of the two components is determined by the inside diameter of the regulating discs. At normal throughput rate it can be displaced only by changing over at least one disc with the drum stopped. In the vast majority of the specifically heavier liquid components however it is possible to achieve a displacement of the interface inwards during operation by increasing the feed so much that more of the specifically heavier liquid reaches the drum per unit time than can pass out via the appropriate regulating disc. For this, however, a very considerable increase in the feed is necessary as very large amounts of liquid can pass out via the appropriate regulating disc. Such overloading of the drum rated capacity however means a considerable reduction in the clarifying capacity so that part of the solids is entrained with the liquid stream. This method fails however where a large number of self-emptying separators are connected in parallel. With central control through a single control device, the considerably increased throughput would be called on from all the separators simultaneously which the pump, installed for normal throughput, or the cross-section of the main conduit, cannot handle. The same can occur with individual control of the individual separators, if by chance, several control equipments call simultaneously for increased throughputs.

In the case of centrifuged liquids containing only small amounts of the specifically heavier component, this method cannot be used at all.

In such cases it is possible to take the specifically heavier liquid from a collecting vessel, or even a specifically heavier auxiliary liquid, in the amount required to shift the interface and mix it with the feedstock to the centrifuge or introduce it separately into the drum. The uncertainties and disadvantages would, however, be the same as with increasing the quantity of feed.

With self-emptying separator drums with discharge of the separated liquid components via paring discs and with self-emptying separator drums of the hermetic or semi-hermetic form of construction, increasing the feed is likewise problematical. With drums of these types it is possible however to shift the position of the interface during operation so that by means of a throttling device the back pressure is varied in at least one of the two outlet conduits connected to the paring disc.

A cream separator drum is known from German Patent 659,724 from which the cream and the skimmed milk are led off by means of a paring disc and where a throttling device is incorporated in each of the

two outlet conduits connected to the paring discs. The throttling devices are to adjust the back pressure for the purpose of froth-free discharge to obtain the required draught of paring discs and in the separation of full milk to adjust the desired quantity ratio of cream to skimmed milk, that is, the desired position of the interface. After the resulting adjustment the throttling devices remain unaltered.

According to the present invention a method of operating a centrifuge adapted to separate a specifically lighter liquid component of a solids-liquid mixture in a self-emptying drum of the centrifuge so that the specifically lighter liquid component is expelled from the drum before solids-discharge orifices in the outer peripheral wall of the drum are opened, the mixture being admitted to the drum through an inlet, and the specifically heavier of the liquid components being led away from the drum by means of a conduit having a valve therein and which conduit is fed from the drum by a paring disc or is hermetically connected to the drum, in which method before closing the inlet and before opening the orifices to commence de-sludging the valve is throttled or closed and is maintained in this position until the specifically heavier liquid component in the drum has moved the interface between the heavier and the lighter liquid components to the inner free liquid level of the lighter liquid component.

Preferably before or simultaneously with the operation of the valve the feed is switched from a conduit for the solids-liquid mixture to be centrifuged to a conduit for a specifically heavier auxiliary liquid used as a displacement liquid.

The method can always be used irrespective of whether the specifically heavier liquid component constitutes the larger or smaller portion of the liquid components of the liquids-solids mixture. If it constitutes the smaller portion, complete closing of the valve is necessary; if it constitutes the larger portion, throttling is sufficient.

For complete expulsion of the specifically lighter liquid component in the case of complete closure of the valve, only so much specifically heavier liquid is necessary as the volume of the drum occupied by the specifically lighter liquid. The duration of switching to be set by the control apparatus is calculated from this volume and the amount of specifically heavier liquid retained in or delivered to the drum per unit time.

According to another aspect of the invention a centrifuge for separating the specifically lighter liquid component of a solids-liquid mixture comprises a self emptying separator drum from which the lighter liquid component is expelled before solids-

discharge orifices in the outer peripheral wall of the drum are opened, the drum having an inlet for admitting the mixture to the drum, a conduit through which the specifically heavier of the liquid components is led away and which conduit is fed from the drum by a paring disc or is hermetically connected to the drum, a valve in the conduit, and control apparatus which, before closing the inlet and before opening the orifices to commence de-sludging throttles or closes the valve and maintains the valve in the throttled or closed position until the specifically heavier liquid component in the drum has moved the interface between the heavier and the lighter liquid components to the inner free liquid level of the lighter liquid component.

Preferably the control apparatus, before or simultaneously with the operation of the valve switches the feed from a conduit for the solids-liquid mixture to be centrifuged to a conduit for a specifically heavier auxiliary liquid used as a displacement liquid.

The invention may be performed in various ways and one specific embodiment will now be described by way of example with reference to the accompanying drawing which is a view partly in cross section of a separator incorporating the invention.

In the drawing 1 is the separating drum into which the liquids-solids mixture to be clarified and separated is fed through conduit 2. During operation, the interface between the separated liquid components is at 3 and the free liquid level of the specifically lighter liquid component is at 4. The specifically lighter liquid component passes freely out of the drum through radial bores 5. The specifically heavier liquid component flows through the annular channel 6 between drum cover 7 and separator plate 8 to the paring chamber 9 from which it is led out by a paring disc 10 under pressure through conduit 11.

When the solids chamber 12 of the drum is full of solids, a sliding piston 13 is pushed by the delivery of a control fluid through conduit 14 to a so-called opening chamber 15 shown in the open position so that the whole drum contents are discharged through orifices 16 in the outer wall 17 of the drum. The drum can also be so constructed that for the purpose of emptying the flow of a control fluid must be interrupted. In any case the valve 20 in the feed conduit 14 for the control fluid must be switched over.

In order to prevent loss of the specifically lighter useful liquid, this has to be forced from the drum to its outlet bores 5 before the discharge orifices 16 are opened. This is achieved, before the feed 24 is cut off by closure of valve 19 in conduit 2 and before the switching over of valve 20 in the

control fluid supply conduit 14 when a control device 18, which controls the operation of valves 19 and 20, throttles or completely closes a valve 21 in the discharge conduit 11 for the specifically heavier liquid component. The volume of liquid to be displaced is relatively small so displacement is quickly executed without increasing the amount of feed. In many cases too it is unimportant whether part of the liquid level reaches to the outlet for the specifically lighter liquid when to raise its purity a further separator is connected in series. A specifically heavier auxiliary liquid as displacement liquid can be led into the drum through conduit 22. In this case the feed 24 has to be switched over from conduit 2 to conduit 22 before or simultaneously with the operation of valve 21 in such a way that valve 19 closes and valve 23 opens.

WHAT WE CLAIM IS:—

1. A method of operating a centrifuge adapted to separate a specifically lighter liquid component of a solids-liquid mixture in a self-emptying drum of the centrifuge so that the specifically lighter liquid component is expelled from the drum before solids-discharge orifices in the outer peripheral wall of the drum are opened, the mixture being admitted to the drum through an inlet, and the specifically heavier of the liquid components being led away from the drum by means of a conduit having a valve therein and which conduit is fed from the drum by a paring disc or is hermetically connected to the drum, in which method before closing the inlet and before opening the orifices to commence de-sludging the valve is throttled or closed and is maintained in this position until the specifically heavier liquid component in the drum has moved the interface between the heavier and the lighter liquid components to the inner free liquid level of the lighter liquid component.

2. A method as claimed in claim 1 in which before or simultaneously with the operation of the valve the feed is switched from a conduit for the solids-liquid mixture to be centrifuged to a conduit for a specifically heavier auxiliary liquid used as a displacement liquid.

3. A method of controlling a centrifuge adapted to separate the specifically lighter liquid component of a solids-liquid mixture in a self-emptying separator drum of a centrifuge substantially as described herein with reference to and as shown in the accompanying drawings.

4. A centrifuge for separating the specifically lighter liquid component of a solids-liquid mixture comprising a self-emptying separator drum from which the lighter liquid component is expelled before solids-discharge orifices in the outer peri-

pheral wall of the drum are opened, the drum having an inlet for admitting the mixture to the drum, a conduit through which the specifically heavier of the liquid components is led away and which conduit is fed from the drum by a paring disc or is hermetically connected to the drum, a valve in the conduit, and control apparatus which, before closing the inlet and before opening the orifices to commence de-sludging throttles or closes the valve and maintains the valve in the throttled or closed position until the specifically heavier liquid component in the drum has moved the interface between the heavier and the lighter liquid components to the inner free liquid level of the lighter liquid component.

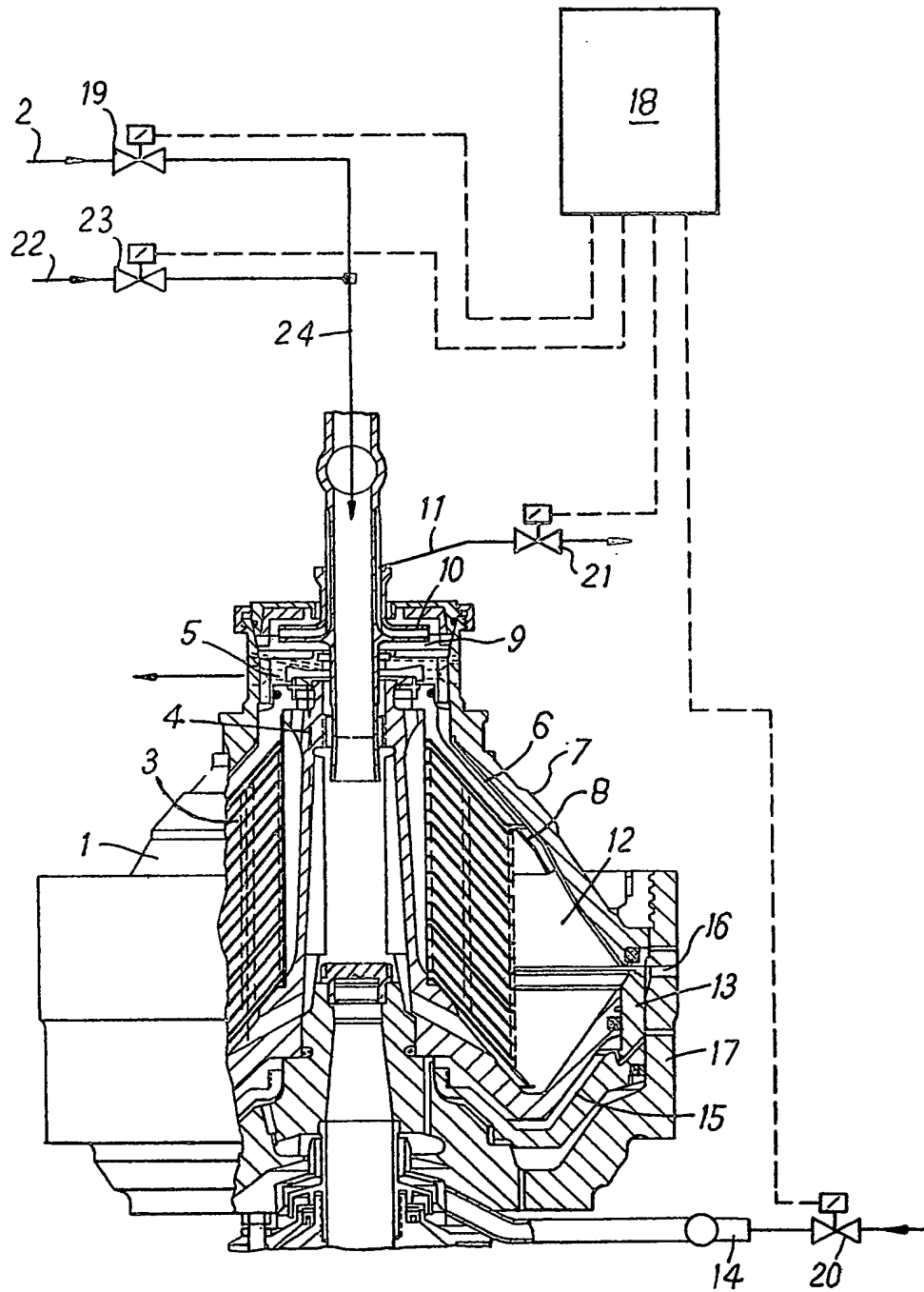
5. A centrifuge as claimed in Claim 4 in which the control apparatus, before or simultaneously with the operation of the valve, switches the feed from a conduit for the solids-liquid mixture to be centrifuged to a conduit for a specifically heavier auxiliary liquid used as a displacement liquid.

6. A centrifuge for separating the specifically lighter liquid component of a solids-liquid mixture substantially as described herein with reference to and as shown in the accompanying drawings.

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